

A PRACTICAL GUIDE FOR THE INSTALLATION AND LAYING OF URBANSTONE SEGMENTAL PAVING UNITS IN A FLEXIBLE PAVEMENT APPLICATION

This Guide Specification is not intended to be used as a contract document and it is not appropriate to include a copy of it in a project specification, nor to refer to it as a standard specification, since each section needs to be reviewed for relevance to particular situations or projects.

Procedures and methods applicable to one project may not be technically or economically relevant elsewhere.

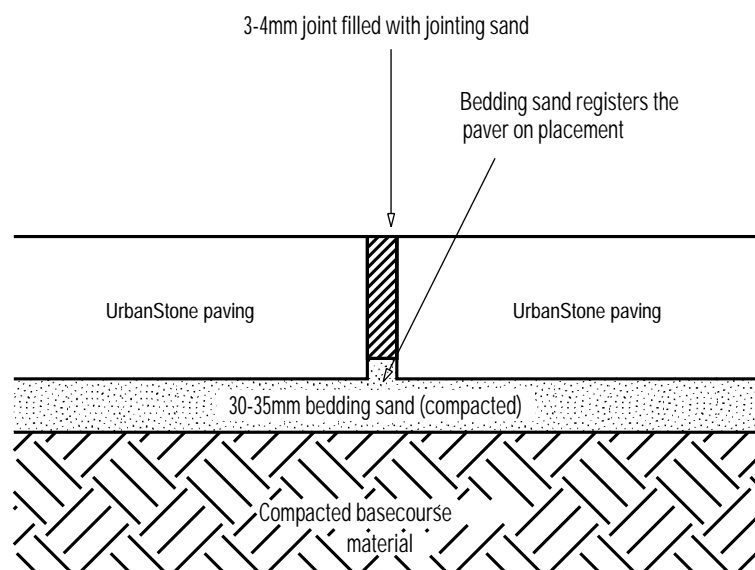
Clauses and selected commentaries have been prepared to cover a probable range of paving situations.

As this information provided is intended for general guidance only and in no way replaces the service of professional consultants on particular projects, no liability can be accepted by UrbanStone for its use in part or wholly.

This Guide Specification cannot, by itself, ensure good results.

Proper design, detailing and the use of sound construction materials and techniques, are equally important.

This guide relates to the installation of UrbanStone paving products in a flexible pavement application.



CROSS SECTION

Typical UrbanStone flexible pavement system

PAVING UNITS.

Concrete paving units shall comply with the requirements of UrbanStone's Paving Specification.

The concrete paving units themselves should be manufactured using the highest quality materials which must comply with the relevant Australian standard. (see relevant section on UrbanStone's paving specifications.)

BASECOURSE TOLERANCES.

The basecourse material shall be trimmed to within + 5mm - 0mm of the nominated base course design levels.

It is essential that the described bedding layer be of uniform thickness, and the basecourse must be trimmed accurately to ensure this.

The surface of the basecourse shall not deviate by more than 5mm from the bottom edge of a 2 metre straight edge laid in any direction on an area of specified uniform gradient or crossfall.

Failure to achieve this may lead to unacceptable localised surface deformation in the finished pavements, or inadequate thickness of sand bedding beneath the pavers.

The basecourse surface shall drain freely without ponding.

At a time nominated by the contractor responsible for the paving, and prior to the commencement of placing bedding sand, the basecourse shall be inspected and approved by the site superintendent.

EDGE RESTRAINTS.

Concrete segmental pavements derive much of their strength from horizontal forces developed between the pavers.

The function of the edge-restraint is to retain the sand bedding and to ensure that units at the edge of the pavement do not creep or rotate under load with consequent opening of joints and loss of laying bond.

These forces, which are generated by the 'wedging' action of the filler material between pavers, must be resisted by installing edge restraints at the pavement perimeter.

Standard municipal profiles for kerb and gutters are suitable edge restraints for most applications of UrbanStone paving.

In addition to the purpose-made / formed units, commonly used profiles for kerbs, gutters and edge strips suited to particular traffic situations are also suitable edge restraints for segmental paving.

However, more substantial cross sections may be required for pavements where excessive expansion, or sand-jacking may occur, (see relevant section on expansion joints and sand-jacking.)

All new edge restraints shall be constructed to local authority standards for dimensions and concrete strengths.

A separate edge restraint may not always be necessary where the UrbanStone paving abuts either an existing building or concrete pavement, or a flexible paving having an asphaltic concrete surface not less than 100mm thick.

In the absence of suitable local requirements, edge restraints shall be constructed using concrete of grade N32.

DETAILING NOTES.

Some of the important detailing requirements for edge-restraints are shown in Figure 3.1, 3.2 and 3.3. These include:

1. The top of the pavers should be slightly above the edge-restraint to which they are draining so the water will not pond on the paving.
2. The edge-restraint should have a vertical or near-vertical side on the face which abuts the pavers so that edge or header pavers can fit in.
3. The basecourse should extend below the edge-restraint for its full width (to minimise the likelihood of the edge-restraint itself being disturbed) except at situations such as walls or pits.

BEDDING COURSE DRAINAGE

On wide pavements and after extended rainfall, water may penetrate the jointing between units into the bedding courses, particularly when the pavement is new.

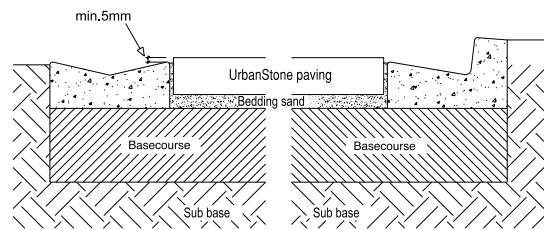
This water can get trapped against the face of the edge-restraint leading to unsightly if only temporary ponding.

The bedding course can be drained into a nearby pit or directly into subsoil drainage where provided.

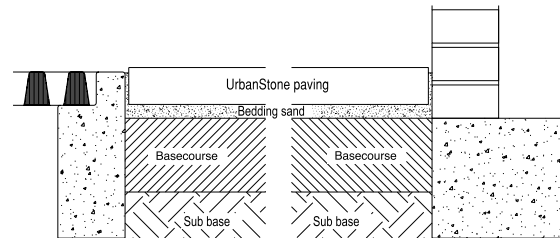
SAND BEDDING COURSE

To ensure good performance in any UrbanStone segmental pavement, it is essential to use appropriate quality materials not only in the basecourse, but also in the bedding layers and in the joint filling.

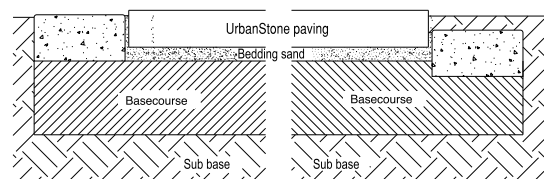
It should not be assumed that segmental pavers will compensate for, or in some way bridge over, a poorly prepared basecourse material.



Dish Drain Figure 3.1 Kerb and Gutter



Pit or Manhole Figure 3.2 Wall



Exposed strip edge restraint Figure 3.3 Concealed strip edge restraint

Water ponding will cause the bedding sand to pump up into the paving joints when trafficked, expelling the jointing sand and subsequently causing a loss of bedding sand, pavement failure, and unsightly staining of the pavers.

The use of geo-fabrics is recommended in this application to ensure there is no erosion of the bedding or jointing sand via the drainage of this water ingress. (See section on, "Design considerations for the specification and installation of UrbanStone segmental paving").

The quality of sand bedding and the uniformity of thickness of the bedding layer has a significant influence on the performance of the pavement.

Important: *The term sand should not be interpreted in the general soils engineering sense. Material such as graded crushed quarry fines can give good performance provided the grading specifications, as detailed in this document, are met.*

1. Materials.

The bedding sand shall be from a single source or blended to achieve the following grading:

Sieve Size	% Passing
9.52mm	100
4.75mm	95 - 100
2.36mm	80 - 100
1.18mm	50 - 85
600 microns	25 - 60
300 microns	10 - 30
150 microns	5 - 15
75 microns	0 - 10

Single-size, gap-graded, or material containing an excessive amount of fines will lead to reduced pavement performance and thus should not be used.

When placed on the basecourse, the bedding sand should have a uniform moisture content.

Saturated material should not be used.

Moisture contents in the range of 4-8% are recommended.

The material should be washed free of soluble salts or other contaminants which can cause or contribute to efflorescence, and cause staining on the paving surface during installation.

2. Spreading and screeding of bedding sands.

The sand bedding shall be spread to a single uniform layer, of sufficient depth over the full width to be screeded, to permit screeding to waste.

The precise depth of loose sand screed required to achieve the nominated compacted thickness shall be determined in the field prior to screeding.

To assist in determining or allowing for the reduction in thickness of the sand bedding from a loose to a compacted condition, the following approach shall be adopted:

As a general guide, and subject to meeting the grading nominated, a sand suited to the manufacture of high quality concrete may be suitable.

The use of grouts or a cement-bound sand is NOT recommended for use in a flexible UrbanStone pavement design.

Should a 'rigid' pavement design be required, please refer to section on a "Practical Guide for the Installation and Laying of Segmental Paving Units in a Rigid Pavement Application".

Efflorescence can lead to reduced skid resistance (see section on efflorescence).

It is important that the bedding sand course be of uniform thickness both to ensure uniform compaction and the avoidance of localised deformations in the completed pavement.

The compaction characteristics of the bedding sand and the nominated thickness of bedding sand must be such that the thickness tolerance of the individual paving units can be absorbed in this compaction process.

2.1 Where the compacted characteristics of the bedding sand are not known, an area of paving may be laid on 40mm of loose sand on the prepared basecourse and compacted with three passes of the plate compactor to be used in the construction of the pavement.

2.2 The extent of compaction, or settlement of the bedding sand under the paving can then be noted and used to determine the precise depth of loose sand required to achieve the finished compacted pavement levels.

2.3 The bedding sand shall be screeded to the nominated design profiles and levels and shall include the necessary surcharge to achieve a uniformly thick layer following compaction in the range 30-35mm.

(Nowhere shall the thickness of the bedding sand layer exceed 35mm following compaction.)

2.4 Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and re-screeded before laying the paving units. The bedding sand shall be maintained at a uniform density but as loose as screeding operations will permit.

2.5 Screeding sand left overnight or subject to rain shall be checked for level and re-screeded where necessary before paving units are placed.

LAYING OF PAVING UNITS.

1. Establishing the laying pattern.

It is important to locate the starting line and to establish the laying face at the commencement of paving to achieve the required orientation and rows of pavers in the completed pavement. The laying pattern and orientation of the rows of pavers should be selected well before paving commences.

Important

Where there is no base or sub base material being used, (that is, where the pavers are being laid directly onto insitu material such as exists around a domestic residence) care must be taken not to compact the insitu material fully before the final screed and laying of paving commences.

Should the insitu material be fully compacted prior to placement of the paving units, the thickness tolerance variation in the nominated paving units will not be eliminated, and lipping between paving units will occur.

Rescreeding will be required as the dampness and moisture will pre-compact the bedding sand.

The use of string lines at no more than 5m centres in each direction, in conjunction with edge-restraints laid correctly to line and level, will assist in maintaining control of alignment and bond and will assist in the maintenance of correct and adequate joint spacing.

Wherever possible paving should commence at or near an edge-restraint, and if possible, on one of the nominated grid lines.

The location of the start line should take this into account.

The alignment of the edge-restraint, in relation to the preferred arrangement of pavers in the completed pavement, should be considered.

It is desirable to work away from materials', delivery points to facilitate orderly paving.

Pave uphill wherever possible to avoid downhill creep and the loss of a uniform pattern.

Paving should never commence from opposite ends or adjacent sides, thus eliminating the likelihood of an unsightly joint where two laying faces meet.

Pavers need to be placed at the correct angle to the start line to achieve the final orientation of the pavers.

A string line should always be established away from curved or unfavourably oriented edge-restraints to position the first rows of paving, in both directions and at 90° to each other.

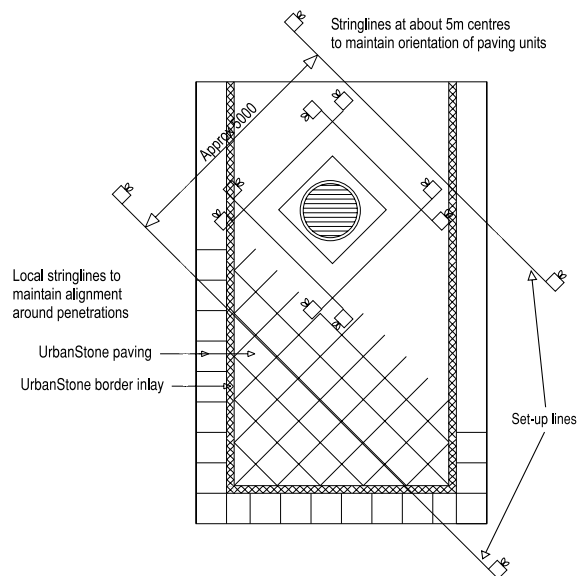
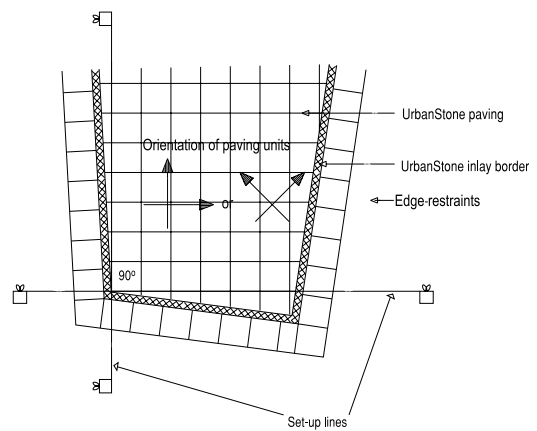
The first few square metres of paving should be carefully placed to ensure that large gaps between pavers do not occur.

Close checking at this stage is important.

In establishing the laying pattern use only whole pavers to start with. Any cutting or filling at edges can be done later.

In starting the laying and developing the laying face, a small uniform gap (typically 3-4mm) is required between pavers.

This gap or joint will be progressively filled with a suitable jointing material as the paving proceeds.



The dimensions of the concrete paving units, typically specified, make allowance for nominated joint widths in the various laying patterns.

2. Developing the laying face

Tight laying in pavements will lead to edge or corner contact.

This in turn will lead to corner or edge spalling and, in some situations, pavement distortion due to expansion and contraction of the pavers themselves.

This situation can also lead to pavement failure due to a lack of sand.

After establishing the laying face, the development and maintenance of control over the alignment of the pavers will avoid wandering of the laying pattern and will assist in paving around landscaping or public-utility features.

String lines will assist in this regard and ensure alignment at all times.

There will be some slight variations in gap widths resulting from the differences in the way individuals place the pavers.

Although rarely a problem, this effect can be minimised by regularly rotating personnel at the laying face.

Pavers are normally dimensioned to achieve small uniform gaps between them.

Nominal widths of 3-4mm, which is a suitable gap, will be obtained using the normal practice of holding a paver lightly against the previous one and allowing it to lightly drop down into position.

Again, maintenance of control over alignment of the laying pattern and uniformity of gap width can be assisted by the use of string lines at about 5m intervals.

PAVING COMPACTION.

After laying the paving, gently align the paving units (if required) using a large screw driver.

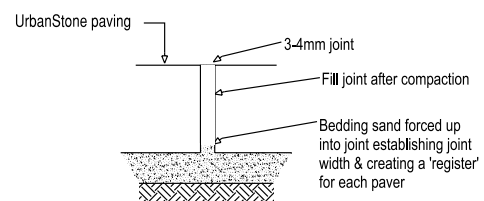
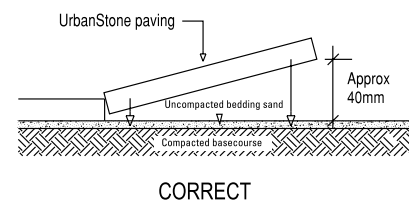
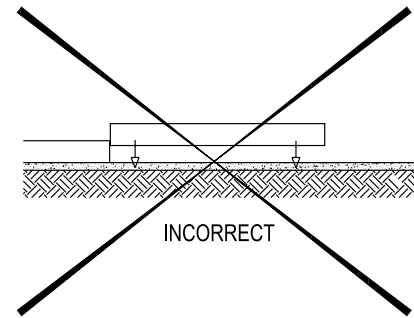
When all grid lines and the laid pattern are visually acceptable, the paving and sand bedding shall then be fully compacted and the surface brought to design levels and profiles by not less than two passes of the suitable plate compactor.

Compaction should continue until lipping between adjoining units has been eliminated.

No special construction procedures are required to achieve the joint widths nominated.

Each unit should be slid down the face of the abutting unit, and gently dropped into position.

This action will automatically space the unit to an acceptable spacing and allow bedding sand to register the paver away from adjacent units until compaction occurs.



Except where it is necessary to correct any minor variations occurring in the laying bond, the paving units should not be hammered into position.

Where adjustment of position is necessary, care should be taken to avoid undue compaction of the bedding sand.

Once joints are filled it is difficult to make any adjustments to pavement profiles or to individual paving units.

Heavy-duty plate compactors weigh approximately 300-500kg, with a plate area of 0.5-0.6m², and deliver a centrifugal force of about 30-65kN.

Light vibrating compactors weigh approximately 90kg and have a plate area of about 0.3m², with a centrifugal force of about 12kN.

The finished level between abutting units shall always be 5mm proud of any drainage inlets and kerbing detail.

Any units which are structurally damaged during bedding compaction shall immediately be removed and replaced.

All compaction shall be completed and the pavement shall be brought to design profiles before the spreading or placing of sand for joint filling.

The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay and such that compaction is completed prior to cessation of construction activity on any day.

Compaction should not be attempted within one metre of the laying face except on completion of the pavement against an edge restraint.

JOINT FILLING.

The small gaps or joints between pavers, nominally 3-4mm wide, are to be filled with a fine sand material.

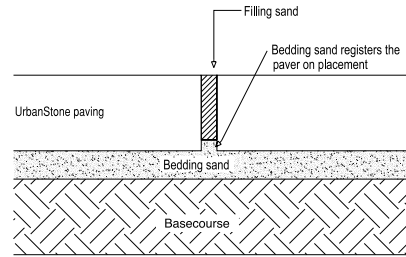
The grading of this jointing material is different to the bedding sand.

As with bedding material, the use of a cement joint is not recommended in a flexible pavement application.

The filling material should be washed free of soluble salts or contaminants which cause or contribute to efflorescence, and additionally stain the paving surface.

A typical grading envelope for joint filling material is as follows:

Sieve Size	% Passing
2.36mm	100
1.18mm	90 - 100
600 microns	60 - 90
300 microns	30 - 60
150 microns	15 - 30
75 microns	5 - 10



Should minor lipping occur between units, this may be overcome by utilising the technique of adjusting the lipped paver by dropping a timber post, (approximately 100 x 100 x 1500mm in size) repeatedly from a height of approximately 100mm on the paver until the lipping is eliminated (being careful not to break the paver).

Care should be taken to select a sand which will not stain the paving units.

If in doubt, conduct a site trial, by simply placing a wet sample of sand on the paving unit for a 24 hour period and then examining the degree of staining on the nominated paving unit and making an assessment of its suitability as a jointing sand.

The filling material can benefit from containing a small amount of dry clay or silt fines passing the 75 micron sieve.

In this way, early water ingress through gaps or joints can be controlled.

Where used, an amount of fines in the range of 5-10% has been found to give good results.

As soon as is practically possible after bedding compaction, and in any case prior to the termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming.

To ensure complete filling of joints, both the filling sand and the paving units shall be as dry as practicable when sand is spread and broomed into the joints.

Prior to acceptance for opening to traffic, all surfaces and pavement structures shall be true to levels, grades, thicknesses and cross-sections shown on drawings.

All pavements shall be finished to lines and levels nominated to ensure positive drainage to all drainage outlets and channels.

The pavement shall then receive one or more passes of a plate compactor as necessary and the joints shall then be refilled with sand as necessary to ensure the joints are completely filled.

The pavement shall be inspected at regular intervals after reaching a stage of practical completion and during the maintenance period to ensure that all joints remain completely filled.

Pedestrian and vehicular traffic should be encouraged to transverse the greatest possible areas of the pavement as soon as practicably possible to assist in setting up the structural integrity of the pavement.

**PROTECTION OF THE PAVEMENT
ONCE OPENED TO TRAFFIC.**

Where the pavement may not be subject to traffic for some time after construction, a small surcharge of joint filling sand shall be maintained over the pavement.

Particular care shall be taken to remove excess sand prior to opening to traffic.

Complete joint filling is difficult when either the pavement or joint filling sand is damp, or where the paving has been laid light with a "zero" joint gap.

Where it is essential to preserve the appearance of the pavement, particularly with light coloured paving, it is advisable to maintain a surcharge of sand over the pavement ahead of the plate compactor, as this procedure may eliminate marking and scarring of the surface of the paving units by the compactor plate.

Once joints are refilled, the pavement is ready to receive traffic.

The retention of a small surcharge of joint-filling sand will provide a convenient supply of sand to make good any partly filled joints and will assist in limiting surface-moisture ingress.